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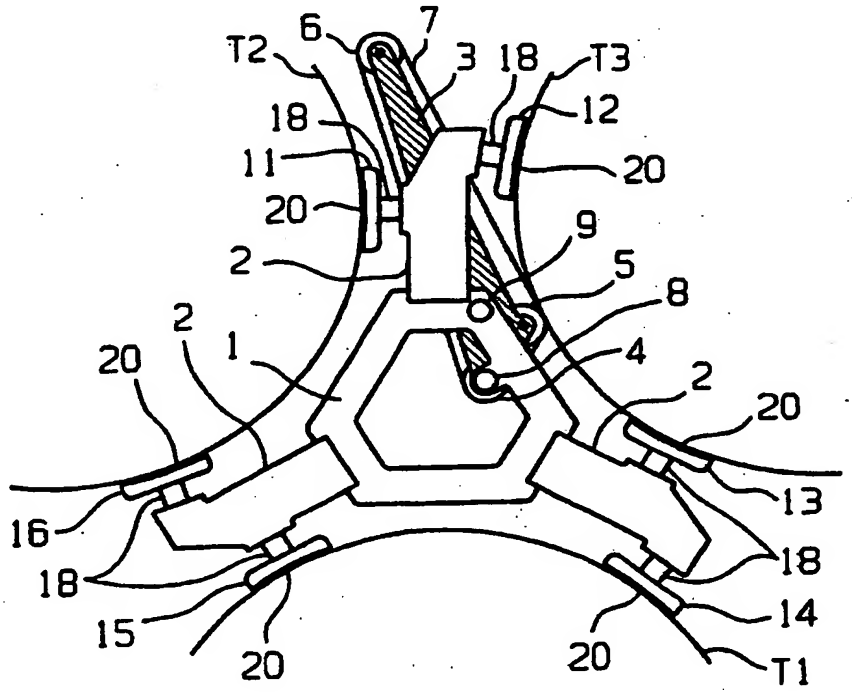
(57) Abstract

An apparatus for grinding surfaces comprising a frame (1, 2), machine tools (3, 4, 5, 6, 7) attached to the frame, and several bearing elements (11, 12, 13, 14, 15, 16) attached to the frame which include a bearing surface (20) leaning on the surface to be ground and/or some other stop surface (T1, T2, T3) and adapted to its shape, and equipment for forming an air or liquid cushion between said bearing surface (20) and stop surface (T1, T2, T3). In an apparatus of the present invention, the attachment of at least one bearing surface (11-16) to the frame (2) comprises controllable adjusting equipment (18) for adjusting the position of the bearing surface (20) in relation to the frame. The present invention provides an apparatus which is especially adapted for grinding surfaces in massive constructions on site. The apparatus may be used in a versatile way, and work may be initiated and carried out quickly without any large-scale preparations.



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Apparatus for Grinding Surfaces

The present invention relates to an apparatus for grinding surfaces, and especially to an apparatus which may be used for the repair of guiding surfaces, for example cylinder surfaces or plane surfaces, or other similar surfaces on site and without having to demount them.

Drying cylinders in a paper machine, for example, get dirty and wear in use, and a dirty and rough envelope surface needs to be repaired from time to time. It may only be a question of cleaning grinding or smoothing grinding, or of stronger machining followed by grinding for repairing the surface. The problem of repair on site is, on the one hand, the placing and support of the machine tool between cylinders, and on the other hand, the guiding of the apparatus during grinding. It is now the general practice to drive the machine tools along guides placed between rollers. In order to avoid the installment of separate frame and control assemblies for the machining process, solutions have been developed that involve supporting the machine tool on the surface to be machined and to some other guiding surfaces available, generally on the adjacent second cylinder surface.

One solution is described in the patent application WO87/02281 disclosing an apparatus placed between cylinders, the frame of which is supported on the cylinder to be machined and on some other cylinder. Bearing devices include rotating balls, roll wheels, or slide blocks so that the device may move supported on the cylinders, and, in principle, the cylinders may also rotate during machining. The machine tool, e.g. a grinding machine, has been movably fastened to the frame, and the machining is controlled by controlling the position and movement of the machine tool in relation to the frame. The problem of this solution is that the roughness and defects in form of the stop surfaces impede the movement of the apparatus, and, on the other hand, make the machining more difficult and

impair its quality despite the fact that one has tried to prevent this by making at least some of the bearing devices flexible.

The patent SE 501250 again discloses an apparatus for machining cylinders, comprising a frame support placed against the cylinder surface to be machined by rollers or other similar parts, and a pressure plate in form of another cylinder placed on the said surface by pressure cylinders. A machine tool, such as a machine blade, is movably attached to the frame support. When using the apparatus, the pressure plate is pressed against the stationary other cylinder, and the cylinder to be machined is rotated. The machining can only be carried out at one place at a time by guiding the movable machine tool within an area in which it is able to move in a fixed frame support. The drawback of the apparatus also is that the machine tool is placed in relation to the frame support, which, supported by the rollers, follows the surface to be machined and thus also its roughnesses and defects in form.

The patent US 2942385 again discloses a machine tool which may include one or more bearing surfaces leaning against the stop surfaces, and grooves to which a pressure medium is fed so that a pressure compensating the weight of the device is generated against the bearing surface and the stop surface, and the apparatus may easily be moved on the stop surface or surfaces. This enables the machine tool to be easily moved on the stop surface or surfaces. No solution for controlling the machine tool is presented.

It is the object of the present invention to provide an apparatus for machining surfaces with which the drawbacks of the known solutions may be avoided and which may be used in a versatile way to repair and grind various surfaces on site.

The object is achieved by an apparatus of the present invention for grinding surfaces, comprising a frame, machine tools attached to the frame, and several bearing elements attached

to the frame which include a bearing surface and equipment to be placed against the surface to be machined and/or some other stop surface for forming an air cushion or a liquid cushion between the bearing surface and the stop surface; it is characteristic of the apparatus that it includes guidable adjusting equipment in the attachment to the frame of at least one bearing element for the control of machine tools in order to adjust the position of the said bearing surface in relation to the control carried out.

Further, the apparatus advantageously comprises control equipment coupled to the adjusting equipment for controlling the adjusting equipment.

In addition, the apparatus advantageously includes equipment for moving it along the surface to be machined, and in a form developed further, it also includes equipment for registering the position of the apparatus and for controlling its movement.

In an advanced embodiment, the apparatus comprises programmable guide equipment coupled to the adjusting equipment of the bearing elements, to the position registration and control equipment in order to control the movement of the apparatus and the position of the bearing elements in relation to the frame in accordance with the programming.

An advantage of the apparatus of the present invention, when compared with prior art devices is, first, that because of the air or liquid cushions placed between the surface parts of the bearing elements and the bearing surface, the apparatus can be easily moved. Due to air or liquid cushions and because, in an advantageous realization, the bearing surfaces are relatively large, the apparatus does not follow small roughnesses or defects in form or disturbing vibrations of the surface to be machined or of the other stop surface. Grinding or other machining may be initiated on the damaged piece. Compared with prior art solutions, the work may in many cases be started

very fast by first installing the measuring devices and then making the repair program, whereafter the work may be initiated. The apparatus of the invention may also be driven on a very dirty surface or on a surface of otherwise poor quality. Thus, it is first possible to remove fast the worst dirt and roughnesses, and thereafter prepare a program for the final repair. The bearing surface may be arranged in relation to the apparatus frame so that the frame extends over the bearing elements at the ends of the apparatus, thus enabling the machine tool to carry out the machining procedure all the way to the edges of the surface to be machined. By equipping the bearing elements with adjusting equipment, when necessary, and by equipping the apparatus with necessary control equipment, an apparatus is provided with which machining may be controlled mainly by controlling the frame movement. If it is desirable to readjust the surface to be machined to one direction or other, the apparatus is guided to follow a line realizing the readjustment. Also control of machine tools is easily added to the control. In order to repair a guiding surface or a similar surface on site, a solution tailored in some way or other is generally needed. The realization and operation of the apparatus of the present invention make it possible to easily tailor an apparatus to suit special needs from certain basic components.

The present invention and its various embodiments are next described in more detail referring to the enclosed drawings, in which

Fig. 1 is a schematic view of an embodiment of the apparatus of the invention;

Fig. 2 is a schematic view of another embodiment of the invention;

Fig. 3 shows a possible realization of a bearing element of the present invention seen from the front and partially in section;

Fig. 4 is a schematic sectional view of a possible realization of the adjusting equipment of a bearing element seen from the front;

Fig. 5 is a sectional side view of the adjusting equipment of Fig. 4 along the line A-A;

Fig. 6 shows a possible realization of a bearing element as a simplified and schematic sectional side view;

Fig. 7 is a schematic view of a possible realization of a baring element seen from below;

Fig. 8 shows a part of an embodiment of the invention of Fig. 1 seen from the front;

Fig. 9 is a schematic view of an embodiment of the invention shown in Fig. 1, including control equipment and accessories, adapted to be used in the repair of paper machine rollers; and

Figs 10(a) and 10(b) show another embodiment of an apparatus of the present invention.

Figure 1 is a schematic view of an embodiment of an apparatus of the present invention for repairing paper machine rollers. The apparatus is placed between rollers T1, T2 and T3. The apparatus includes frame 1 intended for these applications, and projections 2 extending between the rollers; bearing equipment 11, 12, 13, 14, 15 and 16 supporting on the various roller surfaces have been attached to the projections in a way shown in the figures. At the same time, fastening devices 18 advantageously act as adjusting equipment in a way shown later in connection with Figures 3 - 5, with the help of which the position of the bearing equipment may be guided in relation to the frame 1. Bearing surfaces 20 of the bearing equipment, which are shaped to follow the cylinder surfaces, lean against the roller surfaces T1, T2 and T3 acting as stop surfaces. In an apparatus of the present invention it is essential that air or liquid, such as water or cutting fluid, is fed under suitable pressure between the bearing surface of the bearing equipment and the stop surface. This makes it possible for the apparatus to move lightly and steadily on the stop surfaces. If the stop surface is uneven, a thin sheet metal, for example, may be placed on it in order to ease the control of the movement and adjustment of the apparatus. In such embodiments, the basic frame of the apparatus may be constant, but both the projections 2 and the bearing equipment attached to these will

generally have to be tailored to suit the subject of machining. On the other hand, standard measurements are used, for example, in paper machine rollers, thus making it possible to use the same assembly for repairing many objects.

The machine tool used in this embodiment is a grinding carrier, which is shown schematically and in simplified form in Figure 1. Frame 3 of the grinding carrier is attached to the apparatus frame 1. An abrasive band 7 is rotated by a drive wheel 4, and the band passes through two other wheels 5 and 6. In this case, the apparatus is used to grind the roller surface T3. The construction and operation of the grinding carrier is described in more detail later referring to the Figure 8.

Figure 2 shows an embodiment of the apparatus of the present invention, intended for the simultaneous cleaning grinding of several rollers. The apparatus is otherwise similar to that of Figure 1, but two other grinding carriers have been attached to the corresponding projections 2 of the frame 1 for grinding the roller surfaces T1 and T2. The grinding carriers are completely identical with the carrier in Figure 1, and same reference numbers are used to indicate same parts.

A possible realization of the bearing equipment and its fastening and adjusting elements is next described more closely referring to the Figs 3 - 7. Figure 3 is a schematic view of the bearing equipment 11 seen from the front, and at the left end it is shown in section in order to illustrate certain details. It is advantageous to make the bearing elements large enough so that the bearing surfaces would be able to carry the apparatus on the air or liquid cushions to be formed underneath. Between the bearing surface 20 of the bearing element and the stop surface, on which the bearing element in question is supported, for example, air, water, cutting fluid or some other suitable liquid may be led in a way shown by arrows in Figure 3 for forming a cushion. Air or liquid may be used to simultaneously cool the surface.

The bearing surface 11 in Figure 1 is longitudinal in shape, and it is attached to the projections 2 of the frame by corresponding fastening and adjusting elements 18 near both ends. The adjusting elements 18 may be used to adjust the distance between the bearing element 11 and the projection 2 in a way illustrated by arrows drawn beside them. The adjustment is carried out by stepping motors 25 which receive their control from interface 26.

Figs 4 and 5 illustrate in more detail a possible realization of the adjusting equipment. A cylindrical part 18 is fitted into a corresponding aperture in the projection 2. Its upper part comprises crossing runners 35 and 36, the latter of which includes an axis 31 supported and pivoted on the projection 2 at places 32 and 33. An eccentric 34 placed in the runner 35 is attached to the axis. While rotating clockwise (Fig. 5), the eccentric gliding against the bottom 37 of the runner 35 pushes the part 18 downwards and the bearing element 11 away from the projection 2. While rotating anti-clockwise, the eccentric allows the part 18 to glide upwards, and the part 18 is moved to this direction by the pressure acting on the bearing surface. The axis is rotated by the stepping motor 25 (Figure 3), the control led to which determines the position of the eccentric 34 and thus the adjusting element 18. A chamber 38 is arranged in the lower part of the element 18, to which a channel 39 leads. With the help of liquid or air led to the chamber, fine adjustment or elasticity may be provided, thus improving the operation of the bearing element. It has to be noted that the adjustments needed are generally very small, either under one millimetre or in the range of a few millimetres, at the most 10 millimetres.

The construction with which the air or liquid cushion is arranged below the bearing surface is next described more closely referring to Figs 3, 6 and 7. As illustrated in Figure 7, the bearing surface 20 is advantageously divided into several parts of areas 41, each having an own unit 24 as shown

in Figure 3. The idea is that the pressure or amount of air or liquid may be adjusted separately in various areas. Separately adjustable areas may naturally also be formed in the lateral direction of the bearing element. Each area 41 of the bearing surface 20 comprises several extensions 27, each receiving an air or liquid duct 23 from a unit leaning against the area. It is the purpose of the extensions to intensify the formation of air or liquid cushions.

Figures 3 and 6 illustrate the advantageous realization of the bearing element so that it comprises a frame part 22 and a surface part 21 detachably attached to it, the surface part 21 including a suitable surface 20 with extensions 27, and additionally ducts 23 connecting the extensions 27 of each area 41 to the unit 24. The frame part 22 may, for example, be made of aluminium, and the surface part 21 of suitable plastic material. Manufacturing materials may include all suitable metals, plastics, or composite materials.

As illustrated in Figure 3, an elastic flange 28, for example, of rubber, is placed to surround the bearing element. It is needed, especially, if liquid is used to form the cushion. The flange acts as a seal on the edges of the bearing element, and helps the formation of the cushion pretending the liquid from splashing as it is fed under pressure below the bearing surface. The liquid discharging below the bearing surface is collected to a space 29 formed on the flange 28 which may include suction for removing the liquid in as controlled a way as possible.

Figure 8 illustrates the upper part of the apparatus of Figures 1 or 2 seen from the front, from the side of the bearing element 12, illustrating especially a possible realization of the grinding carrier and its operation. The bearing surface 20 of the bearing element 21 faces the viewer, and the bearing element 11 may be seen behind it, the said element 11 being attached to the frame projections 2 by fastening and adjusting elements 18. The frame of the grinding carrier comprises, on

the one hand, a supporting arm extending to the outermost wheel 6, and, on the other hand, a part attached to the apparatus frame 1 carrying the drive wheel 4 and a third wheel 5. A driving motor 8 rotates the drive wheel 4 and thus the band 7 on the wheels 4, 5 and 6. The grinding carrier is able to move in the longitudinal direction of the apparatus along guides 46. The movement is carried out by ball screws 42 driven by the driving motor 9 through cogwheels 43 and cogged belt 44. As can be seen from the figure, the bearing elements 11 and 12, and the attachment and movement of the grinding carrier is arranged so that it is possible for the grinding carrier to move further than the extent of the bearing elements. This enables the machining of the whole surface all the way to the edges so that the bearing elements still remain within the surface area. The grinding carrier may also include equipment for adjusting the tightness of the band, and equipment for guiding the abrasive band in relation to the surface to be repaired and the apparatus frame.

The grinding carrier may vary in many ways within the scope of the present invention. There may, for example, be more wheels guiding the abrasive band arranged in a way that two nearby wheels press the abrasive band against the surface to be ground, the grinding being carried out by the part of the band tightened between said wheels. When necessary, the final grinding may be carried out using an ending band by placing the band on a wheel or reel, and shifting it to another reel while grinding. Also in this case, the band may be led through several wheels, and it can simultaneously be used for grinding several surfaces at a time.

Figure 9 is a schematic view of the apparatus of the present invention with control equipment and accessories, and adapted to be used in the repair of paper machine rollers, the apparatus being arranged between the rollers in accordance with Figures 1 and 2. The apparatus 50 illustrated very schematically moves between the rollers, of which only the rollers T1 and T2 are shown, on the bearing equipment, of which the

bearers 11, 12, 15 and 16 are schematically shown. The apparatus is equipped with a grinding carrier 9. The apparatus is movable with the help of a cogged belt 59 fastened to it. The cogged belt is driven by a stepping motor 57, the belt being conveyed through sheaves and jockey pulleys 58. The longitudinal position of the apparatus can be precisely set and defined by the stepping motor and its control. The frame of the paper machine is illustrated in the figure with reference number 67, and the reference number 66 refers to an auxiliary frame 66, on which a support beam 64 is supported. For controlling the apparatus, the assembly comprises a laser transmitter 52 and receiver 53 which are used to measure the so-called neutral line. Correspondingly, the apparatus includes a measuring unit 55, measuring the travelling line of the apparatus in relation to the neutral line. The operation of the apparatus and of the whole assembly is controlled by a computer or a programmable logic 51. The supply of energy and the input of data is carried out via a cable assembly 56. The wire and cable asesmbly is connected to a terminal carrier 65; the assembly moves in synchronization with the terminal carrier, and it is carried by the supporting beam 64. Also tubes needed for the pneumatically or hydraulically operating parts of the apparatus may be arranged in the same connection. From the terminal carrier 65, the connections are led further to the apparatus 50. The figure also illustrates a collector tray 60 for cutting or cooling fluid, which may be a tarpaulin stretched on wire cables. A pump 61 transfers the liquid back to the repair apparatus 50 through a filter 62 and a pipeline 63.

Next it is described, how the apparatus of the present invention may be used and controlled in an embodiment illustrated in Figures 1 and 9, where the apparatus is used for smoothing grinding of the roller surface T3. Before the repair procedure is initiated, the so-called neutral line is determined for the surface T3. The neutral line is a line parallel to the straight line between the midpoints of rotation of the support bearings; the line may be set, as in Figure 9, by a laser beam

54 guided through the measuring unit 55 in the apparatus. Next, the distance of the neutral line from the level of the surface to be repaired is determined at both ends of the surface. Thereafter, the travelling line of the apparatus is determined, i.e. the position of the apparatus in relation to the neutral line is measured as the apparatus is driven from the one end of the roller to the other. The idea is to drive the apparatus first along the roller surface T1 on the bearing elements 14 and 15 so that these are not adjusted. Upon grinding, the travelling line of the apparatus is in outline known without adjustment, and the apparatus is guided in vertical direction mainly by bearing elements 14 and 15, and in lateral direction by bearing elements 11 and 12 by guiding the position of their bearing surfaces 20 in relation to the frame as described above. The aim of the adjustment is, first, to make the apparatus follow the neutral line as closely as possible, and, secondly, to also keep the apparatus parallel to the neutral line as closely as possible. As is stated above, also the grinding carrier is advantageously equipped with equipment for guiding the abrasive band in relation to the surface to be repaired. In addition, the apparatus advantageously includes measuring equipment which measure the distance from the surface to be repaired using a so-called three-probe measurement method. When the distance of the apparatus frame and the measuring equipment from the neutral line is known, and, on the other hand, when the distance measured by the measuring equipment from the surface to be repaired is known, the repair procedure may be controlled so that exactly the desired form is provided on the surface.

The apparatus of the present invention and its use may vary in connection with the embodiments described above. For example, in the case illustrated in Figure 2, where several roller surfaces are cleaned simultaneously, no exact control is needed to use the apparatus, but it is sufficient to guide all abrasive bands against the surfaces to be cleaned. When repairing rollers with the help of arrangements described above, it is essential that the roller to be repaired has to

rotate. Other rollers may either rotate or be stationary, depending on the embodiment. The apparatus may be used to lapping grinding of the roller in a way departing from the normal lapping grinding so that instead of rotating the abrasive band, the roller to be ground is rotated with great speed, e.g. with a surface speed of 100 m/min. When repairing grooved rollers, lathe tools may be provided to repair the grooves.

Figures 10(a) and 10(b) illustrate an example of another embodiment in accordance with the present invention. Here, guiding surface 88 of a beam 85 supported on the floor 87 by a base 86 is repaired. The bearing equipment 73 are supported on the floor surface, and they are attached to the parts 72 of the frame 71 with fastening and adjusting elements 74 which are controlled by stepping motors 75. The grinding apparatus consisting of a frame 79,a grinding head 77, a grinding tool 78 and an electric motor 80 rotating the grinding head, is controlled by a stepping motor 82 and a screw 81. The apparatus may include measuring equipment and control equipment which, however, have not been included in the description for the sake of simplicity.

The apparatus of the present invention may advantageously be used for many objects especially when it is necessary to repair various surfaces on site, for example in connection with scheduled maintenance of massive industrial and energy production facilities. One embodiment may, for example, be directed to interfaces of power plants, the repair of which is very difficult with conventional methods. The surface to be repaired may, for example, be dozens of metres long, and for the repair of such a surface an apparatus of several metres long may be tailored, which, for example, moves on the floor in a way illustrated in Figure 10. When repairing guiding surfaces, the apparatus may, for example, rest merely on the guiding surface itself, or also on other surfaces of the guide beam. The apparatus may also be adapted for the repair of vertical surfaces with the help of suitable bearing and guiding surfaces, and by moving the apparatus suspended on a cable

wire.

The control of the apparatus may vary to a large extent in accordance with the embodiment. If the apparatus moves on the bearing surfaces with sufficient precision, it is possible to realize only a repair programme with which the repair is carried out. If the mere repair programme is not sufficient, the apparatus itself may be guided along the neutral line by the measuring equipment, and additionally, also the machine tool or tools may be controlled on the basis of measurements continuously provided by the measuring equipment. Also the feed of air or liquid used in the formation of the cushion may be programmed either according to each bearing equipment, or, when necessary, separately in the area of every bearing equipment. As is already stated above, the control may also be conducted in a simple way, in the simplest form completely manually.

It is obvious for those skilled in the art that the bearing equipment, their attachment, and the adjusting equipment related with the attachment may be realized in many various ways. The amount of fixing points may be determined according to needs, and there are many alternative ways to carry out the adjustment. For example, the adjustment may be realized as a wedge, screw or toothed bar solution, and there also are other alternatives for the adjustment control besides the stepping motor. The control may include, for example, measurement and sensor solutions, and feedback solutions.

It is essential for the invention that the machine tool operates on the bearing equipment and on the air or liquid cushions formed underneath, and that the apparatus may be controlled and adjusted in relation to the bearing elements and their stop faces by the adjusting equipment in connection with said bearing elements. The thickness of the air or liquid cushion may vary from a few hundreths of a millimetre to, for example, 2 - 3 millimetres. The positive pressure needed in the cushions is relatively low. For example, if in the case

illustrated in Figures 10(a) and 10(b), the bearing elements are 1 m long and 0.2 m wide, their joint area is 4000 cm2, and a positive pressure of 0.1 kp/cm2 would be sufficient to carry an apparatus of 400 kg.

The invention may vary within the scope of the enclosed patent claims.

Claims

1. Apparatus for grinding surfaces which comprises:
- a frame (1, 2; 71); and
- machine tools (3, 4, 5, 6, 7; 77, 78) attached to the frame including bearing elements (11, 12, 13, 14, 15, 16; 73) attached to the frame, the elements including a bearing surface (20) leaning on the surface to be ground and/or some other stop surface (T1, T2, T3; 87) and adapted to the shape of said surface, and equipment (21, 22, 23, 24, 27) for providing an air or liquid cushion between the said bearing surface (20) and stop surface; characterized in that it includes, for the guiding of the machine tools:
- controllable adjusting equipment (18, 31-39) for the attachment of at least one bearing element (11 - 16) to the frame (2) for adjusting the position of said bearing surface (20) in relation to the frame (1, 2; 71) in accordance with the control received.

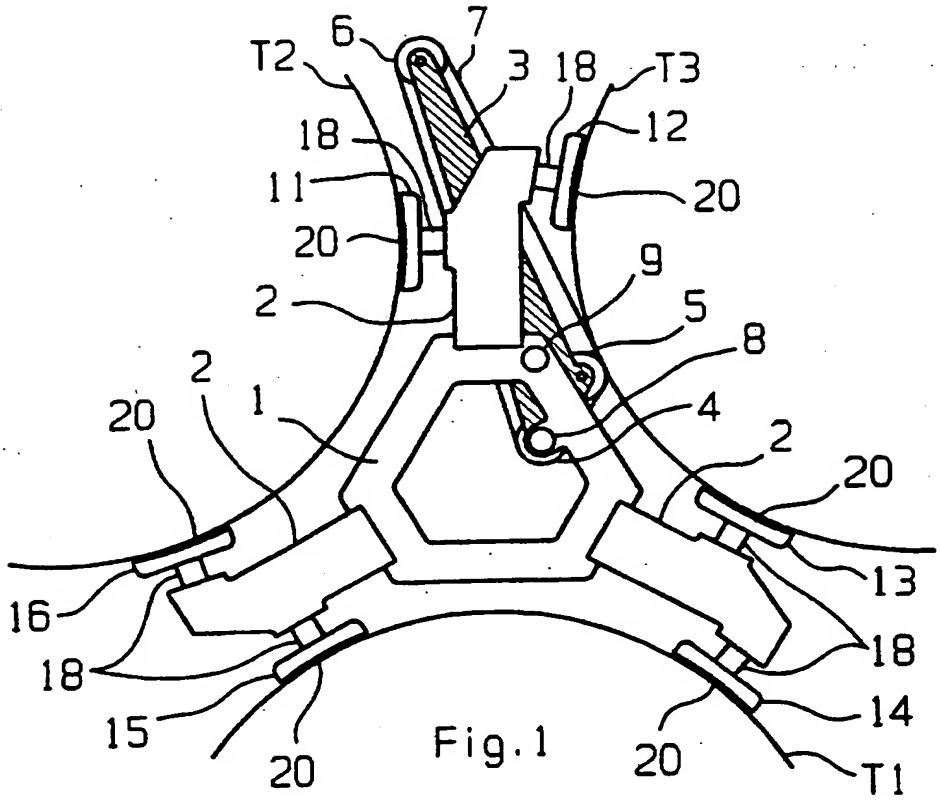
2. Apparatus according to claim 1, characterized in that it comprises guide equipment (51, 52, 53, 54, 55) connected to the adjusting equipment (18) for providing control to the adjusting equipment.

3. Apparatus according to a claim 1 or 2, characterized in that it comprises equipment (57, 58, 59) for moving the apparatus along the surface to be ground.

4. Apparatus according to claim 3, characterized in that it also comprises equipment (57, 59) for registering the position of the apparatus and for controlling the movement.

5. Apparatus according to claim 4, characterized in that it comprises programmable guide equipment, which are connected to the adjusting equipment (25, 26, 18, 31 - 37) of the bearing elements and to the position registration and control equip-

ment (57, 59) for controlling the movement of the apparatus and the position of the bearing surfaces (20) of the bearing elements in relation to the frame (1, 2) in accordance with the programming.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T3
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9
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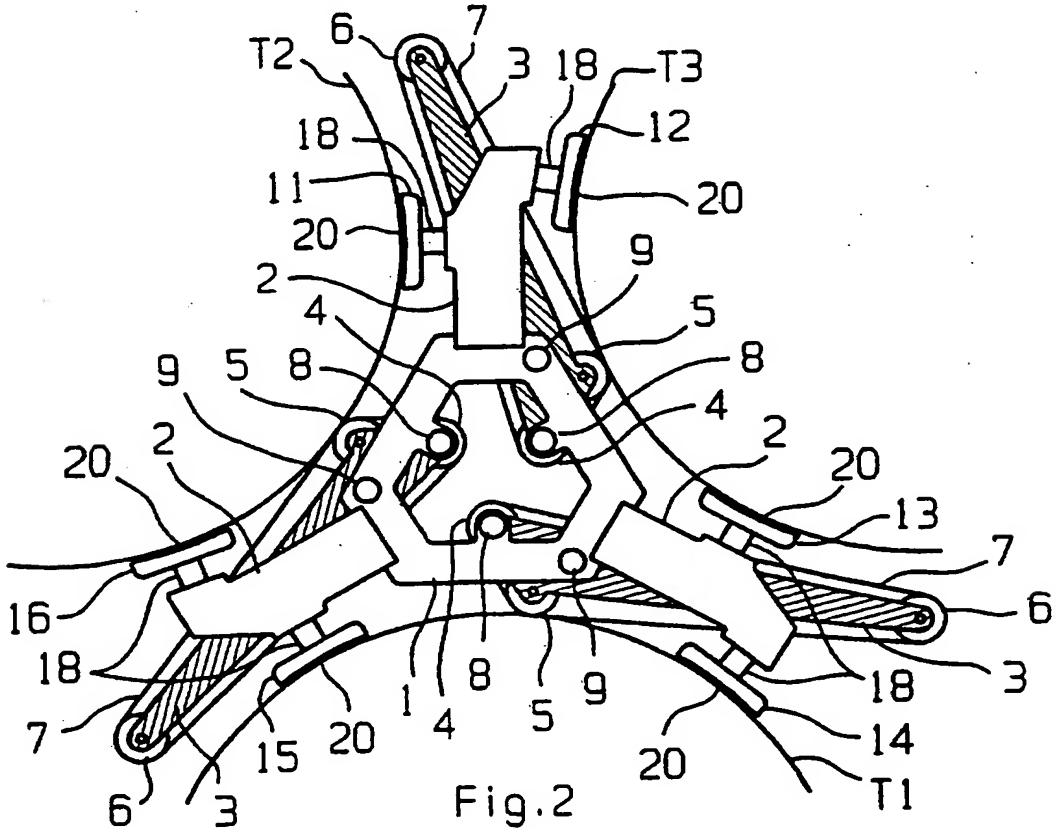
20
20
T1

Fig.1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T1

Fig.2

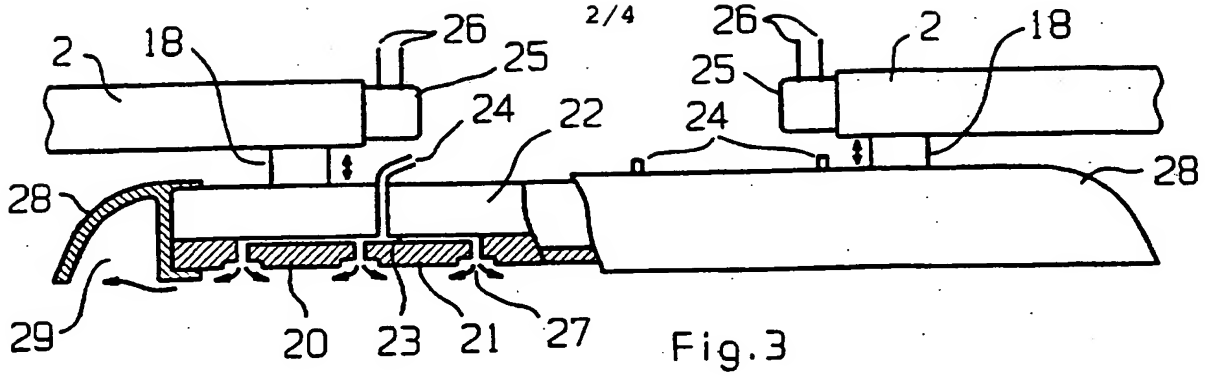


Fig.3

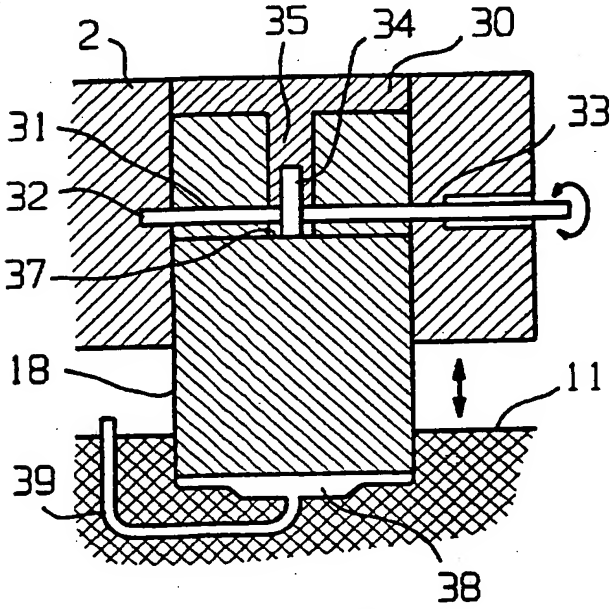


Fig.4

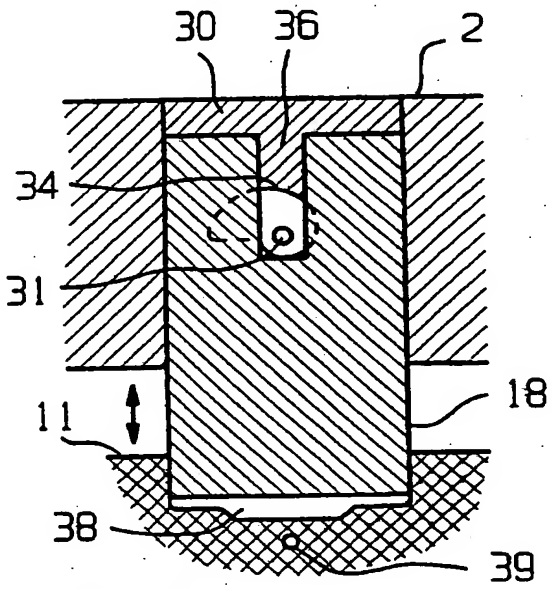


Fig.5

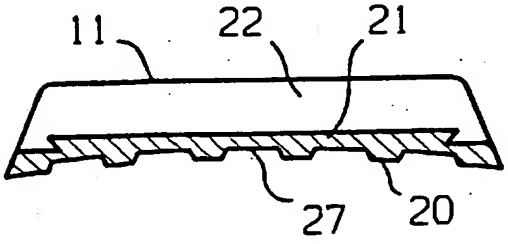


Fig.6

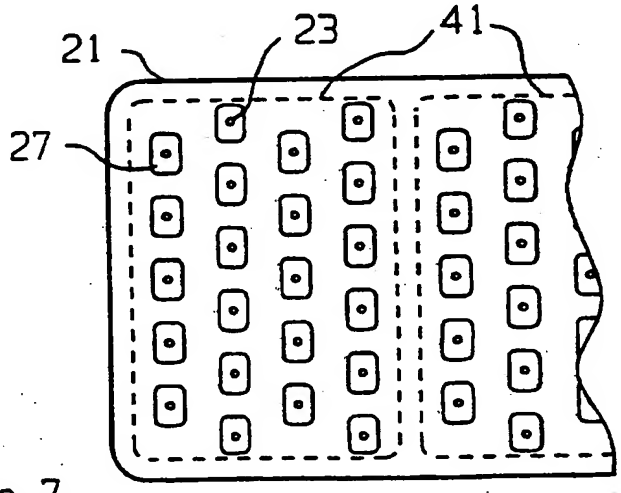
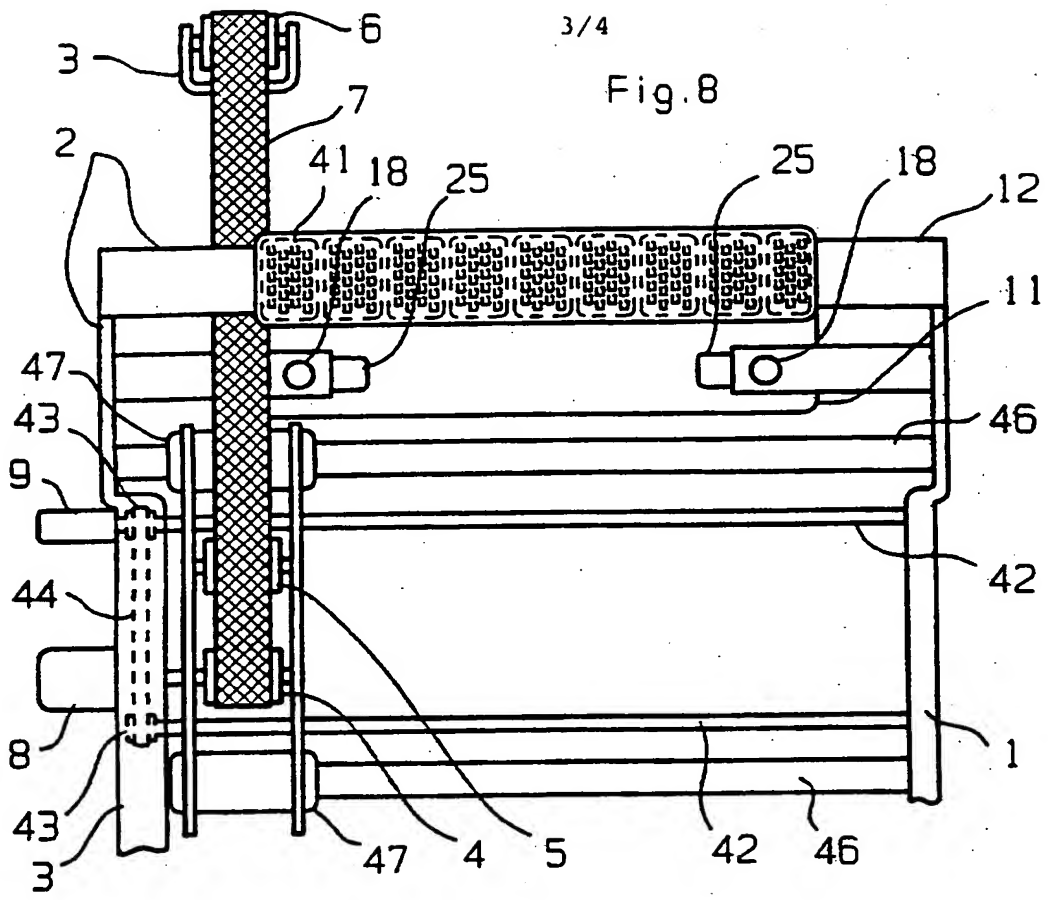


Fig.7

Fig.8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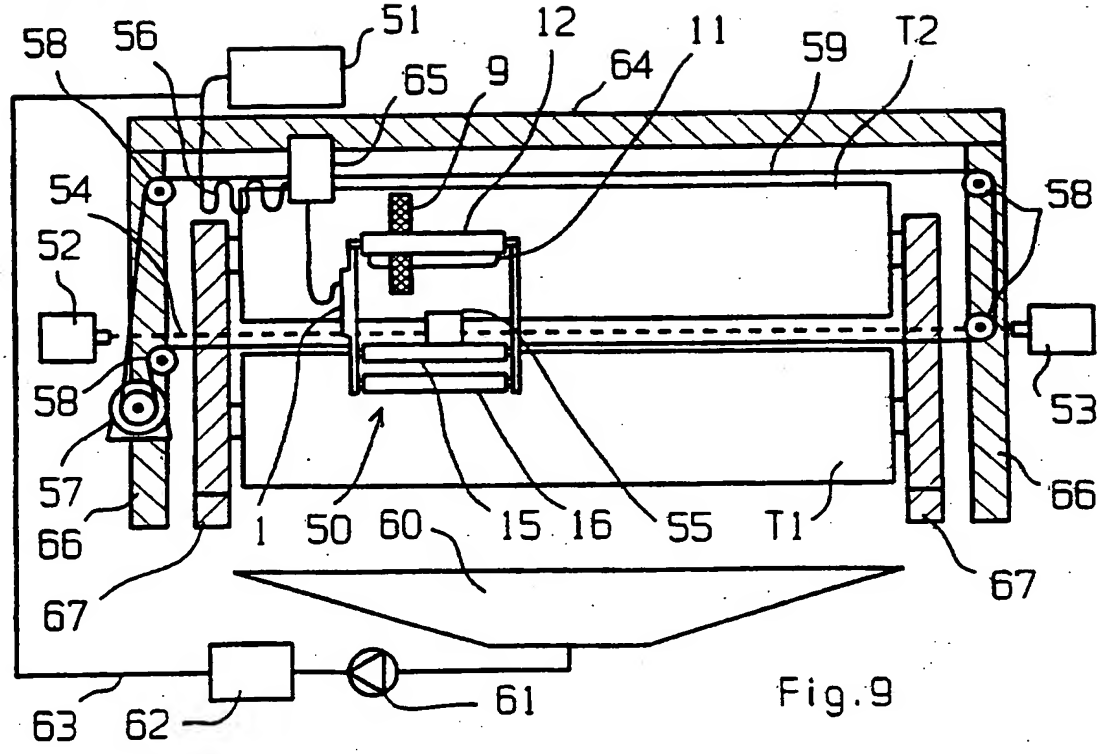
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Fig.9

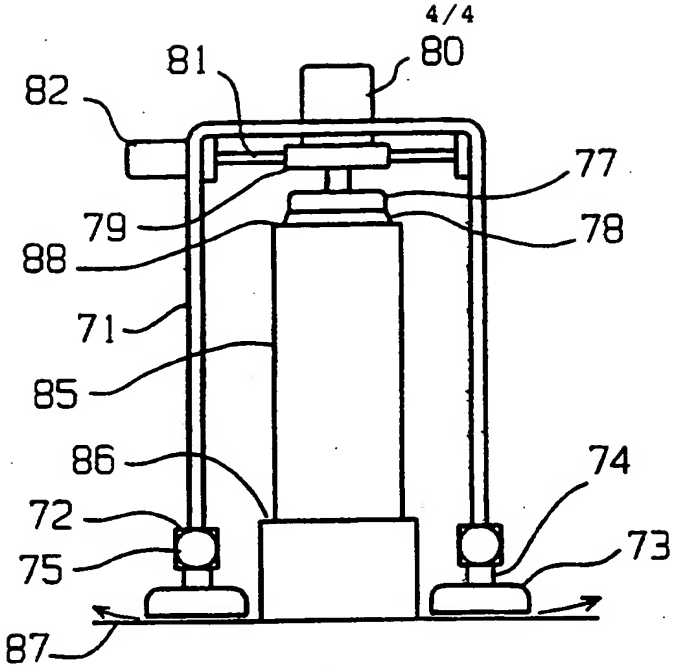

Fig. 10 a

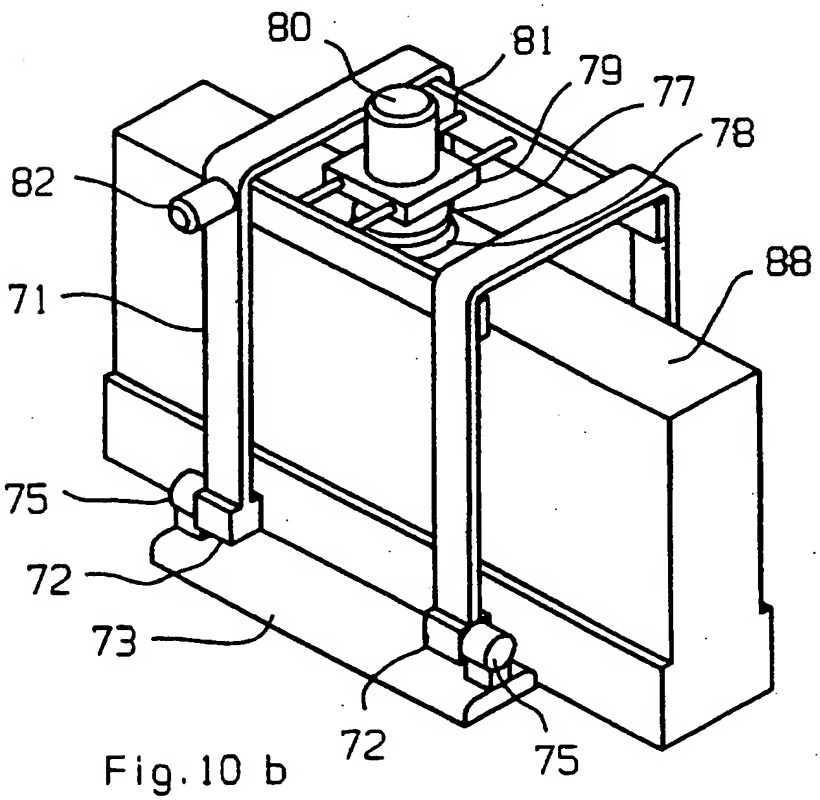

Fig. 10 b

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 97/00122

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B24B 23/08, B24B 5/307
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B24B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	SE 501250 C2 (MO OCH DOMSJÖ AB), 19 December 1994 (19.12.94), figure 1, abstract --	1-5
A	SE 435593 B (LIDKÖPINGS MEKANISKA VERKSTADS AB), 8 October 1984 (08.10.84), figure 1, abstract --	1-5
A	Patent Abstracts of Japan, Vol 9,No 333, M-443, abstract of JP,A,60-166111 (NIHON YAKIN KOGYO K.K.), 29 August 1985 (29.08.85) --	1-5
A	US 4205492 A (MATSUURA ET AL), 3 June 1980 (03.06.80), figure 1, abstract --	3-5

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"E" erlier document but published on or after the international filing date
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 June 1997	12.06.97
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Katarina Ekman Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 97/00122

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4519167 A (HALBERSCHMIDT ET AL), 28 May 1985 (28.05.85), figure 1, abstract -- --------	2-5

INTERNATIONAL SEARCH REPORT

Information on patent family members

20/05/97

International application No.
PCT/FI 97/00122

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